# METHOD FOR MANUFACTURING A MULTI-LAYERED PULP PRODUCT COMPRISING A FILLER BETWEEN LAYERS

## RELATED APPLICATIONS

**[0001]** The present application is a Continuation of co-pending PCT Application No. PCT/ES01/00234, filed June 6, 2001. Applicants claim the benefits of 35 U.S.C. §120 as to the PCT application, and the entire disclosure of the application is incorporated herein by reference in its entirety.

## TECHNICAL FIELD OF THE INVENTION

**[0002]** The present invention refers to a procedure for the manufacture of a multi-layer pulp product, in particular a product selected from between paper and cardboard and which presents the essential characteristic of incorporating a filler between layers.

## BACKGROUND OF THE INVENTION

**[0003]** Many products such as paper and cardboard are constituted by the superposition of layers of fibres which can be of the same type or of different qualities. In multi-layer pulp products the outer layers which grant that paper or cardboard its final appearance are distinguished from the inner layers, which can be constituted by virgin paste, recycled paste or mixtures of the two. In general, the inner layers have a dark colour which sometimes needs to be masked with the outer layers, for which one or several layers of white fibres (virgin or recycled) are usually added, with a layer of pigment being able to be applied to the surface afterwards.

**[0004]** In the manufacture of products such as paper or

cardboard, the fillers are of vital importance since by means of them a saving can be achieved in the amount of virgin or recycled fibre that is used. The object of adding fillers during manufacture is also to improve or acquire certain properties that are desired in the end product: improvement in optical properties such as whiteness, opacity, brightness and colour; improvement in properties relating to permeability to fluids, such as penetration of water or ink, penetration of oil and porosity or resistance to the passage of air. The addition of fillers to the paper also permits the speed of the machine to be increased, which improves its production.

**[0005]** Independently of whether the type of machine for the manufacture of paper or cardboard is a Fourdrinier machine - flat table - or a cylinder machine, or a combination of the two, different ways of introducing fillers into the paper are described in the art.

**[0006]** International application WO-9600816 describes a method and a device for applying a film of a coating material on a network or tissue of fibres in a paper or cardboard machine. The coating material is applied on the surface of the mesh of the pulp product by means of a spraying system at low pressure and high flow. The system is equipped with a series of spray guns adjacent to the mesh of the pulp product. Nevertheless, this procedure is solely intended for the manufacture of mono-layer paper. The mono-layer paper coating thus described has the drawback that it is complicated to achieve a correct distribution of the filler over the entire section of the paper since the penetration of the filler within the fibre mesh will vary radically depending on the point of application.

**[0007]** The application for European patent EP-0 373 276-A1 describes a procedure and device for the continual spraying of adjuvants on a permeable fibre mesh arranged on a belt which is displaced. The system permits spraying of the adjuvants in different states of humidity of the sheet undergoing formation by means of one or various spraying ramps. Each of them is supported by a movable support frame transversely arranged in relation to the direction of displacement of the belt. This ramp is constituted by two ducts provided with nozzles for the transport of the adjuvants, with starch being the product that is sprayed and which penetrates throughout the entire thickness of the sheet.

**[0008]** In spite of the above examples, known techniques for introducing fillers into the interior of the fibre mass present drawbacks such as the low transference of that filler, with a major loss of raw materials taking place which has repercussions on the manufacturing costs. Another drawback consists of the reduction in the mechanical properties of the paper, which become more important as the content of filler increases.

**[0009]** It is therefore necessary to be able to have a procedure with which the transference of filler to the paper manages to be increased, which will also improve its optical properties (whiteness, opacity, etc.) and which does not lead to any major reduction in mechanical properties. All these factors will result in an overall improvement of the manufacturing process.

**[0010]** In the case of multi-layer paper, the above objectives can be achieved by means of the manufacturing procedure of the present invention. This procedure is innovative since, among the known techniques for the

manufacture of multi-layer paper, no description has yet been made of the application of a filler between layers of fibre (which can be of different compositions and can contain different additives), and which acquire the filler prior to being joined together.

## OBJECT OF THE INVENTION

**[0011]** The present invention refers to a procedure for the manufacture of a multi-layer pulp product. Said procedure essentially consists of applying a filler between at least two layers of fibre material in motion prior to the final joining of them together.

## DESCRIPTION OF THE INVENTION

**[0012]** The present invention refers to a procedure for the manufacture of a multi-layer pulp product, characterised in that it consists of:

- the continuous exit of fibre material from one or more entrance boxes of a pulp product manufacturing machine,
- the depositing of said fibre material on one or several sections of the pulp product manufacturing machine, obtaining one or several moving fibre meshes and forming different layers of the fibre material in one or several layer formation sections,
- the draining of those layers during their trajectory on the layer formation section,
- the introduction of filler, by certain application means, between the layers of said fibre material which is being displaced via a conveying means, and
- the joining together of those layers.

**[0013]** The position of the one or more application means with respect to the layer formation section of fibre

material can be variable. The fillers can be proportioned by the application means on one or another layer.

**[0014]** The introduction of filler is done at a distance of between 1 and 70 cm above the moving fibre mesh and preferably between 5 and 40 cm.

**[0015]** The fillers used in the procedure of the present invention are applied by one or several means which are transversely located on the moving fibre mesh, with those application means being arranged in one or several series at different distances from the entrance box for the pulp product manufacturing machine.

**[0016]** The means of filler application can also be arranged with an angle of inclination with respect to the plane of the moving fibre mesh of between 0 and 90 degrees, this angle preferably being 25 degrees.

**[0017]** The final configuration of the application system essentially depends on the speed and configuration of the pulp product manufacturing machine.

**[0018]** According to the procedure of the present invention, the application means of the filler are located in a transverse direction with respect to the direction of displacement of the moving belt. The application of filler can be done by various application means, being able to be introduced in a single application or in successive layers of filler.

**[0019]** The means of filler application preferably consist of nozzles, the filler being applied by spraying of a suspension of the filler between layers of pulp material (the moving fibre mesh is displaced at a speed between 50

and 2000 metres a minute).

**[0020]** The use of nozzles permits the introduction of filler according to a shape selected from between jets of conical shape and plane jets with variable angles of opening, preferably 60º.

**[0021]** The spraying can be done by means of a system that includes nozzles and a return, which provides effective control of the flow or stream in the nozzles. The flow in the nozzles can be adjusted by control means and the said return. The control means are preferably selected from between a pressure regulator, a flow regulator and a pump fitted with a frequency shifter.

**[0022]** The filler is introduced with a transference efficiency of greater than 70%, preferably between 90% and 100%.

**[0023]** The filler can penetrate into the interior of the moving fibre mesh with a depth that is determined by the distance of the application means of the filler with respect to the entrance box. The filler is preferably sprayed at the end of the formation of the sheet at a distance from the entrance box that guarantees little penetration (in order to achieve the best coating of the inner layers).

**[0024]** The manufacturing machine for the product is preferably a paper or cardboard machine, and the multi-layer pulp product is paper or cardboard.

**[0025]** The procedure of the present invention can be carried out in any kind of paper or cardboard machine, so said machine can be a Fourdrinier type of machine, a

cylindrical machine or a machine which is a combination of both.

**[0026]** The filler is preferably of inorganic origin, though it can include organic components.

- Among fillers of inorganic origin in the procedure of the present invention, use is preferably made of calcium sulphate, calcium carbonate, titanium dioxide, talc, kaolin, alumina trihydrate or a mixture of two or more of these components.
- The carbonate can be selected from between a natural calcium carbonate or a precipitated calcium carbonate.
- In an especially preferred embodiment of the procedure of the present invention, the filler that is used is an anhydrous calcium sulphate of high whiteness.
- The calcium sulphate is selected from:
- natural anhydrous calcium sulphate,
- anhydrous calcium sulphate coming from chemical synthesis, and
- anhydrous calcium sulphate obtained by dehydration of a calcium sulphate selected from:
    - natural calcium sulphate hemihydrate,
    - natural calcium sulphate dihydrate,
    - calcium sulphate dihydrate coming from chemical synthesis, and
    - calcium sulphate hemihydrate coming from chemical synthesis.

**[0027]** The calcium sulphate is preferably dispersed in water (by means of vigorous stirring) in proportions of up to 60% by weight in relation to the total mass of the suspension. The granulometry of the filler is also an important factor for the procedure of the invention. The

fine granulometry, coating power and high refractive index of calcium sulphate improve the opacifying capacity of the white layer.

**[0028]** The calcium sulphate used in the invention has a mean granulometry of between 0.5 and 50 µm. The filler preferably has a particle size lying between 0.5 and 10 µm. The filler can include a dispersant in a proportion between 0.01% and 1% of the weight of dry filler.

**[0029]** The filler is applied as an aqueous suspension, the quantities of water and filler being controlled preferably by weighing. Also, said filler is applied by generally controlling the stream by means of a flow regulator and/or by means of a pressure controller.

**[0030]** The rheological properties of calcium sulphate enable a wide range of dry extracts to be worked with, and the optimum quantity of filler between layers can thus be determined for each type of quality to be manufactured.

**[0031]** In a preferred embodiment the filler is applied as an aqueous suspension consisting of between 99% and 40% of water. It preferably consists of between 90% and 70% of water.

**[0032]** The quantity of filler deposited on the fibre mesh lies between 0.5 $g/m^2$ and 50 $g/m^2$, and very preferably between 5 $g/m^2$ and 15 $g/m^2$.

**[0033]** The filler can optionally include one or more additives. For example, it can include various types of starches or mixtures of them.

**[0034]** The fibrous material constituting the multi-layer

pulp product produced by the procedure of the present invention can be constituted by a paste selected from among virgin paste, recycled paste, paste that has been de-inked or not, all kinds of paste whitened or not, and mixtures of the above.

**[0035]** The present invention has as an additional object a paper or cardboard product produced according to the described procedure.

**[0036]** The advantages obtained with the procedure of the present invention are multiple:

- A saving in filler is achieved owing to filler retentions of higher than 70% being attained without the use of outside chemical agents.
- Another additional advantage of the procedure of the present invention is that it permits inner and outer layers of the end product to be of inferior quality, thus considerably reducing the cost of the end product. If the same quality is maintained for the inner and outer layers, then the application of filler between layers permits an end product to be obtained that has a better overall quality.
- Another additional advantage of the procedure of the present invention is that the white prelayer or prelayers (if the end product is constituted by several outer white layers) can be replaced, with the desired optical properties being maintained.
- Another additional advantage of the procedure of the present invention is that it also permits a reduction in the grammage of the white layer, maintaining the desired optical properties of the end product, thereby considerably reducing the cost of the manufactured product.
- Another additional advantage of the procedure of the

present invention is that by means of using calcium sulphate an improvement in the efficiency and homogeneity of the coating between layers is achieved.

**[0037]** The following figures and example show in a more detailed manner certain aspects of the invention.

## BRIEF DESCRIPTION OF THE FIGURES

**[0038]** Figure 1 show a series of positions of a device conceived for the introduction of fillers according to the procedure of the invention and suitable for different configurations of machine. In that figure:

- 1 represents an application means of filler,
- (a) shows a section of a combination of Fourdrinier machines and cylindrical machines,
- (b) shows a section of a combination of cylindrical machines, and
- (c) shows a section of combination of Fourdrinier machines.

**[0039]** Figure 2 shows a system of introducing filler by spraying, said system consisting of a series of nozzles permitting the suspension of filler to be sprayed in jets with a conical or plane shape. Represented in that figure is a jet with a plane shape 2 or conical shape 3.

**[0040]** Figure 3 shows a possible configuration of the application means of filler with respect to the moving fibre mesh. In that figure:

- "h" represents the distance between the means of application and the surface of the fibre mesh
- 4 represents the sprayed filler
- 5 represents the pulp product and
- 6 represents the support for the moving pulp product

(fabric)

**[0041]** Figure 4 shows a diagram of the preparation, storage and spraying of filler in the form of suspension. In that figure 4 can be seen a section of storage of the filler 7, a section of dilution of the preparation 8, a section of storage of the filler suspension 9, a sprinkling system 10 which includes a final batch 10a, and a section of the device for the introduction of filler between the layers of pulp product 10b.

**[0042]** Figure 5 shows the section or sprinkling system 10 of figure 4. It is a standard diagram of the introduction of filler in the form of suspension. In figure 5 can be seen a filler filter 11, the flow control point 12, the positions of the flow meters 12a and 12b, and the section of the filler spraying ramp 13 between the pulp product layers.

**[0043]** This system can be subject to specific modifications permitting both the elimination or addition of elements and the modification by means of other more sophisticated components.

## DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

**[0044]** Described below is the use of the present invention in the manufacture of multi-layer paper, specifically white Biclass.

**[0045]** Provided on a conveyor belt of a Fourdrinier type paper machine being displaced at 142 m/s is a mesh of cellulose fibres coming from recycled white paper. At a distance of 40 cm (h in figure 3) above the surface of the fibre mesh a filler spraying system is provided, having 14

nozzles like those shown in figure 2. The angle of inclination $\alpha$ - as shown in figure 3 - of the nozzles with respect to the moving fibre mesh is 25º.

**[0046]** By means of an installation similar to that described in figure 4 and under conditions of vigorous stirring, a 25% aqueous suspension is prepared of anhydrous calcium sulphate (coming from the dehydration of calcium sulphate dihydrate) with an average particle size of 3 µm. The quantities of water and filler are controlled by weighing. By means of the spraying system described in the above figure, 17 $g/m^2$ of anhydrous calcium sulphate are proportioned on the surface of the moving paper (10% by weight on the white layer production). The flow of filler is controlled by means of an automatic flow regulator, the spraying point being located at the end part of the formation table and after the water line. At the end of the formation table the joining of the white layer with the grey support takes place.

**[0047]** In this way, a 90% transference of filler takes place, and a very considerable increase in the whiteness of the outer white layer of the paper can be observed.

**[0048]** The results obtained by the application means of anhydrous calcium sulphate in the interlayer following the procedure described above were compared with the results obtained using kaolin as filler in the mass of the white layer. The conclusions of the comparison are as follows:

- For an objective whiteness value of 77, the grammage of the white layer was reduced from 81 to 65 $g/m^2$, with the consequent economic saving.
- For the same value of grammage of the white layer (81 $g/m^2$) and maintaining the same mechanical properties as were achieved with kaolin, it was possible to increase

the percentage of ash from 18% to 23% by means of spraying with calcium sulphate.

- The transference of filler went from 40% for kaolin to 90% for calcium sulphate. The spraying with calcium sulphate avoided the use of the retention agents needed in the case of kaolin.
- The values of delaminating and of "Dennison" waxes remained similar at all times 0.199 joules/$m^2$ (95 ft.lb/$in^2$) and 0.01892 joules/$m^2$ (9 ft.lb/$in^2$) respectively, for the two cases.
- As calcium sulphate is a filler with superior whiteness and opacity characteristics to the kaolin used in the mass, this permitted the use of recycled paper of poorer quality (and therefore much more economical). Using kaolin, recycled white paper with a minimum whiteness of 75.5 had to be used, while with calcium sulphate it was possible to reduce this whiteness to 72.5.
- The whiteness of the final paper by means of spraying with calcium sulphate between layers increased potentially as a function of the percentage of filler applied.

**[0049]** Having illustrated and described the principles of the invention and its application to a particular case, it can be appreciated that it is in no way limited to the example presented here. Numerous modifications can be made to the method and the apparatus in order to adapt it to diverse cases and configurations without departing from the principles of the invention described in the following claims.